

Attorney Docket No.: SIT-0106
Inventors: Esche and Nazalewicz
Serial No.: 09/954,994
Filing Date: September 18, 2001
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In the Specification

In accordance with the Examiner's suggestion, please replace the paragraph beginning at page 4, line 29, with the following rewritten paragraph:

-- Figures 1A, 1B, and 1C show a side view of a pneumatic unit comprising an upper pressure chamber 10 and a lower pressure chamber 12 present on either side of a non-linear spring 14, a load supporting rod 16, a top support plate 18, a bottom support plate 20, a supporting plate 22, fasteners 24 and connectors 26. The non-linear spring 14 is comprised of an upper metal support 28, an elastomeric isolator 30, and a lower metal support 32. The upper pressure chamber is comprised of a top side 34, an upper cylindrical side wall 36 with a top edge and a bottom edge, upper rubber bellows 38, an upper air inlet 40, and a bottom ~~side side~~ 42 to the upper pressure ~~chamber 42~~ chamber 10. The lower pressure chamber 12 is comprised of a top side 44, a lower cylindrical side wall 46, lower rubber bellows 48, a lower air inlet 50, and a ~~bottom bottom~~ 52 to the lower pressure ~~chamber 52~~ chamber 12. The upper pressure chamber contains upper rubber bellows 38 with a top edge 54 and bottom edge 56. The top edge 54

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of the upper rubber bellow **48** is secured between the underside of the upper pressure chamber top **34** and the top edge of the cylindrical side wall **36**. The bottom edge of the upper pressure chamber upper rubber bellows **38** is secured between the bottom edge of the cylindrical side wall **36** and the top edge of the lower metal support **32** of the nonlinear spring **14**. The lower pressure chamber **12** contains a lower rubber bellows **48** with a top and bottom edge. The top edge of the lower rubber bellow **48** is secured between the bottom side of the lower metal support **32** and the top edge of the lower pressure chamber cylindrical side wall **46**. The bottom edge of the lower rubber bellow **48** is secured between the bottom edge of the cylindrical side wall **46** and the top edge of the bottom support plate **20**. The upper pressure chamber upper rubber bellows **38** and lower pressure chamber lower rubber bellows **48** secured in this way each take on a doughnut shape. An upper air inlet **40** present on the cylindrical side wall **36** of the upper pressure chamber **10** allows air to be pumped into the upper pressure chamber **10** which transfers increased load onto the nonlinear spring **14**. A top support plate **18** is in contact with the top side of the upper pressure chamber **10**. The top

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support plate **18** is attached by fasteners **24** to connectors **26** which are attached to the top side of a supporting plate **22**. The bottom side of the support plate **22** is attached to the bottom support plate **20** by multiple fasteners **24** to the under side of the bottom support plate. A load supporting rod **16** runs from the top support plate **18** through the center of: the space in the center of the upper rubber bellows **38** in the upper pressure chamber **10**, the nonlinear spring **14**, the supporting plate **22**, space in the center of the lower rubber bellows **48** in the lower pressure chamber **12** and the bottom support plate **20**. The load supporting rod **16** has a smaller diameter at the lower end and a larger diameter at the upper end. The larger diameter end of the load supporting rod **16** passes through the center of the top support plate **18** and through the space in center of the doughnut shaped upper rubber bellows **38** of the upper pressure chamber **10**. Due to its larger dimension, the larger diameter end of the load supporting rod **16** can not pass through the hole in the top of the upper metal support **28** of the nonlinear spring **14**. The actuator is part of a pneumatic system including a pump, pressure chambers, and a pressure reservoir to facilitate rapid response

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times for stiffening and softening. By introducing air into the upper pressure chamber **10**, a load is applied to the nonlinear spring. Similarly, the lower pressure chamber **12** reduces the load on the non-linear spring **14**. A load due to pressure in the upper chamber is added to the external supported load while a load due to pressure in the lower chamber is subtracted from the external supported load. The nonlinear spring **14** stiffness changes with varying loads. By applying pressure to either the upper pressure chamber **10** or the lower pressure chamber **12**, the natural frequency of the system may be regulated. One or two pressure chambers may be present depending on the application. Using this device, adaptive vibration attenuation is implemented by passive vibration mounts that allow the adjustment of their dynamic stiffness characteristics in response to changes in the excitation or loading conditions. The mount stiffness is varied by combining a passive vibration mount with highly non-linear force-deflection characteristics with a one-directional or bi-directional pneumatic actuator. These adjustments of mount characteristics result a change of the natural frequency by shifting the operating point of the nonlinear spring. Non-invasive, non-contact sensors are used together with hardware- or

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software-based signal processing to identify the excitation
displacement and/or force signal and to generate the appropriate
adjustments of the passive vibration mount characteristics.--